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The invention relates to an arrangement to the improvement of the vision, in particular in vehicles after the preamble of the claim 1.

An extremely important safety aspect in vehicles such as automobiles, LKWs, buses, locomotives and in aircrafts is an excellent vision with all weather conditions. Schlec of visibilities with dark combined with wet roadways or with mist were again and again a cause for series of Massenkarambolagen on highways in the last years, which would have been avoidable with better vision.

With the analysis, whereby poor visibilities come off, it shows up that photosensitivity lacking eye the cause is usually not. The eye would quite be in the attitude to notice also with small illumination a scene relative good. A cause of poor visibilities is however generally disturbing bright light, that the perception of the required scene for example a road process obstructed. Disturbing light can be for example the light of wrong set or ligt up head lamps of accomodating vehicles, furthermore diffuse backscattered light of the own head lamps with mist or the bright sunlight between two tunnels. Such interfering light makes excessive demands of the Kontrastumfang and the adaptation ability of the eye, so that a scene is more perceptible only more insufficient.

Known approaches to the solution of this problem are based either on the use of infrared thermal image cameras or are as radar distance alarm systems designed. Infrared thermal image cameras are a little more useful due to the used materials very teue and therefore for applications of masses. The spatial resolving power of the microwave radar is insufficient also with mm waves for the recognition of a scene in distances from 5 m to 300 m complete.

The invention is the basis therefore the object, an other arrangement to the improvement of the vision, in particular in vehicles to indicate.

The invention in in the claim 1 described. The Unteransprüche contain advantageous embodiments of the invention.

Substantial one with the invention is the orthogonality between transmission polarization and receipt polarization, whereby a significant improvement information signal spurious signal of the ratio achieved becomes, like still incoming described, and whereby in a simple manner the compatibility several similar arrangements, z. B. in accomodating vehicles, ensured is.

The invention is subsequent reference bottom at examples on the images still incoming illustrated. Shows

Fig. 1 an illumination optics in side view

Fig. 2 a Empfangsoptik in side view

Fig. 3 a schematic illustration of strewing situations.

The inventive arrangement essentially consists of the assemblies

- Illumination optics
- Empfangsoptik
- Representation optics

the subsequent single and in their cooperation still detailed described are. With all optics electronic systems are included to the drive and evaluation also in the term.

1. Illumination optics

The illumination optics according to invention contains a light source in the close infrared one (800 Nm to 2000 Nm), for the example of ATMs/ATM-read semiconductor lasers around 800 Nm. The maximum light power is appropriate for example between 500 mW and for 5 W and would be thereby comparable head lamps normal with the light power. If a particularly large range of the system required and no endangerment are to be feared by glare or eye damage, for the example with aircrafts, then the laser power can become also substantial high selected. Only if a smaller light power becomes required, then the light power can become also for example by reduction of the electrical laser stream the bottom maximum value lowered.

By a headlight optics with lens and/or mirror the light becomes radiated into the solid angle range planned to the monitoring.

For illuminating the solid angle range in principle three proceedings are to be differentiated

a) simultaneous illuminating of the whole range by two-dimensional beam effect of the laser beam

b) Expansion of the laser beam in only a direction with simultaneous narrow bundling in the orthogonal second direction and swivelling (scan) of the illuminated flat solid angle cutout in the second direction
c) Swivel a bundled laser beam in two dimensions for scanning illuminating of the entire solid angle range.

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Fig. 1 shows those bottom managing b) described prefered embodiment of the illumination optics with a semiconductor laser H, whose output light becomes over a lens L, for example a Zylinderlinse or a combination by spherical and Zylinderlinsen, the monitored area steered intended in the plane of the drawing narrow bundled and vertical the plane of the drawing the corresponding expansion of the solid angle range (< for example> 3 DEG to 20 0) expanded and over the mirror S into. By the narrow bundling in the plane of the drawing becomes only a flat cutout DELTA alpha (z. B. DELTA alpha =0,05 DEG - to 0.5 DEG) of the entire angular range 0 illuminated. By dumps of the mirror the Winkellage alpha of the flat angle cutout DELTA alpha changed registered against a reference direction R and so the entire angular range 0 knows re-painted over, D. h. the entire solid angle range to be illuminated. The movement of the mirror and the image pickup in the Empfangsoptik are synchronized. In place of the day/night mirror also a rotary mirror assembly or a linear displaceable lens can be provided.

By aligning the diode laser crystal and eventual by an additional inserted polarizing filter P1 the polarization of the radiated light set becomes.

With the embodiments b) and C) can become by a temporal modulation of the laser light, which can become achieved by a temporal variation of electrical heading for Rome, the brightness of the illumination dependent by the reflected beam angle varied, the example with the embodiment b) dependent vo angle alpha, then for example the foreground of a scene (z can. B. a road process) less bright illuminated become than the background; thus for example the weakening of the laser light increased with increased removal can become compensated and an even illuminating of the scene achieved. Alternative one or zusätzli can become a temporal modulation with higher frequency performed. The modulation can be for example sinusoidal with a frequency of 1-10 kHz or pulse-type with a pulse-prolonged of 50-100 mu s and a pulse distance of 100-1000 mu S. Thus an illumination of the scene with a striped or punctiform Mu can become achieved, whereby a plastic emphasis of subject matters can become achieved such as cars and of the road process.

The light source can become ligt up always full operated. The bundle diameter of the light at the accessible exit surface can amount to 5 cms to 25 cms depending upon laser power to ensure in each case eye security; eye security can become by changing over to wavelengths around 1500 Nm substantially increased.

2. Empfangsoptik

The Empfangsoptik contains a television camera, for the example a CCD camera, with high sensitivity. The increase of the sensitivity a picture reinforcement can become used. The contrast reinforcement, Datailverstärkung and Bildspeicherung a video signal processor can become used. The camera the observed illuminated scene, for the example a road process or a landing field.

Before the optics O of the camera K is a polarizing filter P2 mounted, whose passage direction vertical stands to the direction of the emitted laser light; this polarizing filter closes thus the passage of the own emitted light and the light of accomodating vehicles same polarization on for example a value from 10< -3> to 10< -5>; a same polarization direction is to be planned for all vehicles, eventual also by a regulated alignment after the gravity field of the earth on exact vertical or horizontal.

A spectral line filter F disposed, which is transmissive for the arrangement-own laser light, is more other however an high inhibition for the residual visible and infrared spectrum exhibits, thus both the daylight and the normal searchlight beam of accomodating vehicles strong absorbs, for example on one of 10 -3 before the optics O< of the camera> to 10< -5>.

Additional one can become the other reduction of interfering light also a spatial absorption filter not shown forwards camera mounted, that the example the bottom portions of the image weakens and thus that bright illuminated foreground weakens in favor of the less illuminated background. An other alternative in addition represents a spatialer light modulator before the camera, which then targeted weakens only the too bright portions of the image in the camera system. A such light modulator can be for the example as liquid crystal modulator constructed.

The optics O of the camera generated on the light sensitive image area B of the camera an image of the illuminated region, which can become then other evaluated.

Depending upon embodiment of the illumination optics the image in the camera simultaneous on the entire image area or single image parts develops develops for corresponding scanning illuminating of the solid angle range temporal successively. With use of the preferable embodiment (B) of the illumination optics with, a vertical in addition strong focussed (DELTA alpha) light beams broad in a plane, which become over the monitoring angle range PHI swung (Fig. 1), favourable-proves met with the pivoting angle alpha of the illuminated bundle synchronized measures in the Empfangsoptik, which ensure that only light from the illuminated strip contributes to the screen layout and does not become disturbing effective by Mehrfachstreuung from other angular ranges incident light. This knows for example by a synchronous striped diaphragm in the Empfangsoptik success, moved with the light bundle turning, preferably however for the image pickup in the light sensitive image area B an arrangement with line by line separate electrical controllable photosensitive elements inserted and it will become only in each case the elements of the line (n), which the instantaneous angle cutout illuminated by the illumination optics corresponds, activated. Alternative one in addition can be also only a narrow strip with or few lines of the image area the Ablendemechanismus provided described similar in connection with a moved mirror or a moved lens with the illumination optics, so that different image parts become temporal successively received of the same photosensitive elements.

3. Illustration

Of the Empfangsoptik the captured image becomes displayed by the representation optics the driver (or pilots) in suitable way. Preferably for this an image derived from the Empfangsoptik becomes projected into the field of view of the driver or pilot. The image becomes for example for this generated as television picture on a screen and after type of a Head UP display on the windscreen projected. Thus the projected image of the observation area and the D of the eye direct observed image if possible good for covering arrive and over with all brightness conditions a sufficient bright and high-

contrast image are present to have, are favourable-prove the attitude and the brightness of the projected image variable more adjustable. The adjustment can be manual and/or automatic provided. For the automatic off-centering for example television camera could become the position of the eyes of the driver or pilot certain and from it the optimum adjustment of the representation optics derived over a measurement system with Intrarot LED un.

In place of in the light field of the projected image naturally also another representation method, z can. B. a separate screen or in connection with other evaluating devices also an optical and/or acoustic warning signal for automatic recognized danger situations provided its. A separate screen knows z. B. also provided its for the observation in reverse direction.

4. Cooperation

The invention takes advantage of above all the actual known effect that polarized no longer on a diffuse reflecting surface radiated light is after the reflectance. Degree of the remainder polarization is dependent of the nature of the surface. Into that most cases that is almost unpolarisiert, partial by far diffuse reflected light is also circular or elliptical polarization to be observed. For the instant invention this means that of illuminated subject matters, persons, houses, trees, other vehicles, retroreflectors, roadway and/or. Runway etc. reflected light to a large extent unpolarisiert is and thus for instance a portion of this diffuse reflected light of the polarization-selective Empfangsoptik received, located between 30% and 50%, will can. This portion represents the useful signal in the Empfangsoptik.

In contrast to this the infrared light of accomodating vehicles and at mists, water droplets represent and such to backscattered light of the own illumination optics of spurious signals for the Bildauswertung in the Empfangsoptik and are therefore as far as possible to be suppressed.

The infrared light of accomodating vehicles with similar infrared illumination optics becomes in a simple manner as far as possible that in all arrangements the same transmission polarizations, suppressed by the fact, horizontal or vertical, provided are. The infrared light of accomodating vehicles is vertical for the receipt polarization of the own illumination optics polarized and by the polarizer P2 effective is then faded out.

The Rückstreuung of the light at molecular strewing particles becomes as Rayleigh scattering, at larger strewing particles such as z. B. Water droplet as Mie scattering referred. With both types of the scattering that is direct backscattered light linearly polarized with the same polarization as the emitted light, if the transmission polarization lies in the observation-planar, those by the location of the illumination optics BO, the Empfangsoptik EO and the lighting direction A (and/or. Observation direction C) is stretched, or vertical on this plane stands. Bottom this prerequisite is thus that direct backscattered light same polarized as the emitted light and becomes from the polarizer P2 of the Empfangsoptik suppressed. Since vertical to fading out the infrared illumination of accomodating vehicles the transmission polarization can be only horizontal one or, illumination optics becomes and Empfangsoptik of a vehicle favourable-proves one above the other or to horizontal next to each other vertical (vector t in Fig. 3) disposed.

Described polarization preservation applies only to direct backscattered light. In addition, with mist Mehrfachstreuung arises, those to effected that interfering light falls also with other polarization on the Empfangsoktik EO and cannot any longer complete suppressed of the polarizer P2 become. In Fig. 3 is for the case of the Mehrfachstreuung one point of strewing Z1 viewed that light of the illumination optics BO not only toward C direct to the Empfangsoptik but also into other directions, for example b strews. Toward b the scattered light becomes again scattered at a second point of strewing Z2, z. B. also toward D on the Empfangsoptik EO. The point of strewing Z1 can become as new light source for the Mehrfachstreuung considered. The observation-planar is no more stretched by A and t then, but by b and t.Die both planes a generally bottom angle and the polarization direction from Z2 toward D of the scattered light different of 0 DEG and 90 DEG do not cut themselves are appropriate for parallel for transmission polarization, D. h. the light backscattered from 72 to the Empfangsoptik has a parallel to the polarizer P2 of the Empfangsoptik polarized component, which becomes apparent as interfering light in the rule. Considered one one the Mehrfachstreuung over the entire solid angle, then results a depolarization light, which can be depending upon density of the points of strewing (mists) about 10% to 40%.

In Fig. 1 and 2 outlined and already described combination of illuminating and observation only a flat angle cutout DELTA alpha the reduced disturbing influence by Mehrfachstreuung or by foreign light significant only a small portion over a substantial larger space distributing of the interfering light detected will and thus opposite one not solid angle lessons illumination and observation the useful signal/spurious signal ratio greatly improved becomes covering.

A first embodiment for the arrangement from illumination optics and Empfangsoptik is in Fig. 4 and Fig. 5 outlines. Of the illumination optics BO generated light beams LB is in a dimension, z. B. vertical narrow bundled (z. B. DELTA alp =0,05 DEG) and over an angular range PHI = 15 DEG) more pivotable. The pivoting angle against a reference direction R is referred with alpha. Vertical one to the plane of the drawing of the Fig. 1 is the light beam on an angle R (z. B. R=20 DEG) expanded, which in the Aufblickskizze after Fig. 4 shown is. The solid angle range LE monitored of the Empfangsoptik is in the same plane focussed narrow in addition as the light beam LB expanded and vertical so that light beams and transmitting room angles overlap and the hatched observation range (Fig to a large extent. 4, Fig. 5) form, in which for example a subject matter G is. Light beams and transmitting room angles are for space scanning synchronous around one to the connecting line t between Empfangsoptik and illumination optics parallel axe more pivotable. Of the subject matter the G from the cutout reflected light illuminated by the light beam becomes with the polarized component of the Empfangsoptik, vertical to the emitted light, EO received.

By Mehrfachstreuung outside of the angle cutout DELTA alpha, z. B. Z2 (see Fig. 2) backscattered depolarisiertes light at least partly the polarizer P2 penetrates, but due to a strip screen is faded out or on not activated elements of the image area of the camera meets and in the Empfangsoptik not effective in such a way does not become. Beside the light reflected of the subject matter G however still interfering light becomes the Empfangsoptik backscattered from the total volume V of the observation range. To the suppression of this interfering light, which is parallel to the light polarized radiated of the illumination optics, the Empfangsoptik the P2 contains polarizing filters.

An other significant reduction of the influence of this interfering light is possible in accordance with a preferable embodiment thereby that the Empfangsoptik is not in the plane of the light beam LB, but from this out offset disposed, as in Fig. 6 outlines. A lap of the light beam LB with the transmitting room angle LE takes place only in a comparatively small

volume section V min, so that also interfering light is only from this small volume the utilizable light overlaid reflected of the subject matter G into the narrow focussed transmitting room angle to the illumination optics. Since in addition the lap takes place only in a region more removed from the illumination optics and Empfangsoptik, where the light intensity (= light power per surface) both by the divergence of the light and by the losses in mists or such. already significant is smaller than in close range of the lenses, arises a significant reduction of the light backscattered on the Empfangsoptik, against what the light of this measure, reflected of the subject matter, does not become affected.

There the overlapping area of the light beam and the fan-like transmitting room angle in Fig. 6 only one distance section, becomes favourable-proves the transmitting room angle LE in swiveling direction of broad selected as the light beam LB takes off. Preferably several part becomes solid angle LE1, LE2. . simultaneous by the illumination optics monitored. Several subspace angles correspond for example in the illumination optics to several detector lines of a camera. The arrangement of the detector elements in the image plane of the camera puts the geometry of the part solid angle fixed in connection with the focal length of the camera image optics.

Fig. a side view of the arrangement shows 7 also in the vertical distance D above the illumination optics BO disposed Empfangsoptik EO with a camera K of the focal length f. On a roadway sp be a subject matter G in the observation range. To the illustration are in Fig. 7 the narrow focussed angular ranges of light beam and subspace angle by beams and/or. Lines represented. Fig. 8 shows, like Fig. 4, a plan view on the arrangement.

Before the illumination optics generated focussed light beams strong in the plane of the drawing is in Fig. 7 as beam 1 shown. This beam meets to the one in the distance L1 the subject matter G, of which a beam 4 to the Empfangsoptik reflected will and in the image plane B of the camera K on the position Y4 imaged becomes there. On the other hand the beam meets 1 at the subject matter past in the removal L2 the roadway, of which a beam 3 to the camera reflected will and into the position Y3 of the image plane imaged becomes. To the beam 1 the parallel ray, which became from in the infinite located subject matter a reflected, would meet in the position Y2 the image plane B. The vertical height of the image plane is referred with BV and takes off the vertical angular range PHI. Since the position Y2 with the angular position of the beam 1 is correlated; Y4 can become the removal L1 of the article certain as L1= fxD/b. with fixed angular position from the difference b of the vertical positions Y2. Thus a possibility is given to the measurement of removals. Dependent of the distance D and the focal length f cover the difference b used for distance regulation for example between two and twenty detector lines of the camera.

Since the Empfangsoptik from the plane of the light beam is offset out, know illumination optics and Empfangsoptik also in a vertical on the plane of the light beam standing plane, in the outlined example in the distance D disposed become thus one above the other.

In Fig. 8 is a plan view on the situation after Fig. 7 outlines. Of the illumination optics radiated light beams LB meets in the removal L1 the subject matter G and an illuminated narrow strip on its Oktiken of facing side. On that the subject matter G a shade range SCH throws the Oktiken of opposite side. The lateral parts of the light beam leading past the subject matter meet in the removal L2 the roadway. The light, by the edge jets 4, reflected from the strip to the Empfangsoptik, 4 min represented, illuminated on the subject matter G, which in the image plane B of the camera into the positions X4 and/or. X4 min imaged become, lead in the image plane to an horizontal strip of the length g between X4 and X4 min with the vertical position Y4.Das of the roadway in the removal L2 the Empfangsoptik EO reflected light lead in the image plane to lateral of X4, X4 min within the width Bh of the image plane located strip with a vertical position Y3. In the two-dimensional image plane B develops thereby for the assumed angular position of the light beam in the illustration of the image plane after Fig. 9 thick shown line BP. This can exhibit intensity variations in itself still. When swivelling the light beam develop new in each case image parts, which result in a composite laminar illustration of the entire observation area (PHI, R).

Beyond that a reduction of the influence of interfering light, which becomes from the observation area scattered into the Empfangsoptik, is possible with an arrangement also from the plane of the expansion of the light beam out offset Empfangsoptik. Here the finding becomes at the basis laid that the interfering light in adjacent observation area angular pitches with approximate same intensity arises. By correlation of separate detector elements from the associated solid angle ranges and/or by correlation the utilizable light signal from one knows temporal separate gained informations over the intensity distribution of the light received in the Empfangsoptik possibly. present breakdown background emphasized become.

A development of the invention plans not to only rate the backscattered light diffuse in the mist as breakdown contribution but those therein as shade outlines informations targeted, z still located in the observation area contained of subject matters. B. by smart image processing to evaluate. Here both can become the polarized component evaluated vertical to the emitted light parallel and those, or it can be done without a polarizing filter whole. With utilization that vertical to the emitted light polarized component in the backscattered light, which presupposes its depolarization with the diffuse scattering in the mist, arises the advantageous effect that in close range an high illumination intensity, but a small depolarization is given, while in larger removal the depolarization increases, but the intensity is smaller, so that the intensity dynamics of the stray light effective in the Empfangsoptik are small over the removal.

In Fig. 8 is by the illumination optics illuminated the region, from the light to the Empfangsoptik is scattered back, hatched. From this derived can become that in the horizontal image area between X4 and X4 min Rückstreuung up to a removal L1, into which arises to lateral image portions up to a removal L2. In connection with Fig. it results 8 from it that in the horizontal image portion between X4 and X4 min lightens backscattered light the image plane from the upper edge to the position Y4, during in the horizontal lateral portions in Fig. 9 hatched bright area up to the vertical position Y3 reaches. Since the bright area of the backscattered light ends in each case, where a subject matter or the roadway stops the other propagation of the light, a portion of the outline of the article can become removed from the shade outline in the image plane. By swivelling the light beam and in each case retake of an image the entire subject matter can become scanned and shown. Since only the shade border becomes exploited, the contrast of the article is independent of the reflectance characteristics of the article, to the environment. The contrast can with this type of the evaluation in certain periphery through increases the intensity of the backscattered light increased to become, whereby however a limitation is to be considered by disturbing Mehrfachstreuung.

Since the infrared light is not detected by the eye and a disturbance of Empfangsoptiken of accomodating vehicles because of the Orthoganalität of sending and receipt polarization excluded is, the illumination optics always full can be ligt up.

By the expansion of the light beam in a direction also sufficient eye security is ensured.

The invention is not general from advantage, on the described prefered application in road vehicles limited, but, to the improvement of the vision, for example also in stationary observation mechanisms.